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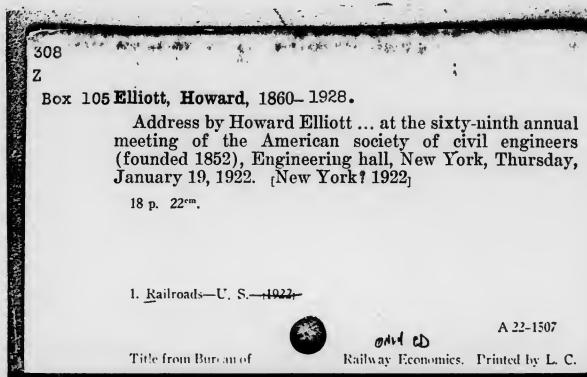
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Address by
Howard Elliott, C. E., LL. D.
Chairman, Northern Pacific Railway Company
at the
Sixty-ninth Annual Meeting
of the
American Society of Civil Engineers
(Founded 1852)

ENGINEERING HALL, NEW YORK
Thursday, January 19, 1922

"Railroad Transportation"

To be asked to speak before the American Society of Civil Engineers is a great compliment which I appreciate and for which I thank you. I received the degree of Civil Engineer after a course of study in the old Lawrence Scientific School of Harvard University, since then supplanted by the Harvard Engineering School, a school well organized and equipped to give courses in all branches of Engineering. I have found my training as an engineer of inestimable value to me in railroad work. Fate decreed that I should drift into the financial, commercial and administrative branches of railroad management, and I have not been privileged to carry the blue shield of the Society, but for many years I have been an Associate member and have on my watch chain the red shield. I consider it one of my most cherished possessions.

*Personal
Experience*

It was my good fortune from 1903 to 1913 to be President of the Northern Pacific Railway Company.

In that decade the owners and directors spent more than \$100,000,000 in improving the property in a physical way and a very large amount of work was done in making the Northern Pacific a transportation machine that could produce a maximum of transportation units with a minimum expenditure of physical energy; this, for the ultimate purpose of giving to the growing communities between Lake Superior and the Pacific Ocean, good transportation at the lowest practicable rates consistent with a fair return upon the fair value of the plant.

In that most interesting work I had the assistance as Chief Engineer, first of Mr. E. J. Pearson, resourceful in design and experienced in using modern railroad facilities, and now President of The New York, New Haven and Hartford Railroad Company, where he has been doing some of the same kind of work in improving the New Haven as was done on the Northern Pacific; and later of Mr. W. L. Darling, a past master of railroad engineering problems.

To work with these trained and experienced engineers was a genuine pleasure and I found that my education and limited amount of actual work in the field were most helpful in coming to conclusions and approving plans for numerous pieces of work both large and small.

*The Stockwood
Fill on the
Northern Pacific*

One interesting piece of work was the revision of the line and grade on the Northern Pacific so that heavy tonnage trains could be moved from the Red River Valley over the divide into the Mississippi Valley. A grade of 0.30 per cent eastbound was decided on in place of the existing maximum of 1½ per cent. To accomplish this required an embankment 7.3 miles long, maximum height 49 feet, with total yardage of 5,155,694 of which 4,067,844 are above the plane of the original ground line and 1,087,850 below.

After the work was started it was discovered that there was a prehistoric lake bed underneath part of the heavy fill; the old lake bed being

filled with a sedimentary deposit of sand, saturated with water, for about 20 feet, underlaid by soft blue and yellow clay.

The result was that the heavy fill broke through the surface and the continuity of the 0.30 per cent grade line became broken, forcing the introduction of a short piece of 1 per cent grade, which, however, does not limit eastbound train tonnage except in bad weather when helping engines have to be used. This work was begun in March, 1906 and completed in December, 1909.

For ten years there has been little further subsidence and it is possible that in due time the entire embankment can be brought up to the original 0.30 per cent grade.

Attached to this paper is a memorandum giving details and prints of this rather interesting piece of grade revision.

*The Line Between
Vancouver, Wash.
and Portland,
Oregon*

Another interesting work with which it was my privilege to be associated was the building of the Spokane, Portland & Seattle Railway, a 0.40 line between Spokane and the Snake River, and 0.20 along the Snake and Columbia Rivers to Portland, making a very fine line for the development of the Inland Empire and the Columbia River basin, and capable of being operated very cheaply when any substantial tonnage is moving. The entire line along the Columbia and Snake Rivers and from the Snake River to Spokane is most interesting from an engineering (as well as from a commercial) standpoint, with much heavy rock work through and around basaltic cliffs and with many heavy fills across "coulees."

The S. P. & S. Railway Co. is owned jointly by the Northern Pacific Railway Company and the Great Northern Railway Company. The S. P. & S. uses certain parts of the Northern Pacific, the bridge over the Columbia River at Pasco, and the entrance to Portland on the west bank of the Willamette River; and the old Northern Pacific main line to Goble, Oregon, where connection is made with the Astoria and Columbia River road, purchased by the S. P. & S. thus forming a low grade line between Spokane and Astoria at the mouth of the Columbia. There is also a branch 156 miles long to Central Oregon. The Northern Pacific Company, with its main north and south line between Portland and Tacoma and Seattle, joined the S. P. & S. (of which it is a one-half owner) in creating a remarkable piece of railroad from the north side of the Columbia River at Vancouver, Wash. to the west bank of the Willamette River at Willbridge, in North Portland, Oregon.

This line is made up of the bridge across the Columbia River, Hayden Island and Oregon Slough; 6467 feet of bridge of which 2194 feet are girder spans over Hayden Island and 4273 feet truss spans over the two channels, with draw spans of 467 feet and 333 feet respectively. The maximum depth of foundation below low water is 80 feet and below the base of rail 126 feet. There are about three miles of road across the St. John Peninsula in Oregon in order to reach the Willamette River, which has a heavy bluff on the east side. In order to maintain the grade line, this bluff had to be cut and 2,357,000 cubic yards of material were taken out. Then comes the Willamette River Bridge 1767 feet long with draw span 521 feet long, the largest double track draw span in the world

at that time. The maximum depth of foundation below low water is 86 feet and below base of rail 148 feet.

There were used in the construction of the two bridges:	
Masonry and Concrete.....	79,012 cubic yards
Steel Superstructure	22,175 tons
Timber in Foundation	6,927 MFM
Piling	296,860 lineal feet

The two bridges cost \$4,160,000; a sum far less than the bridges would cost today.

Work was begun on the foundations for the Columbia River Bridge February 8, 1906 and superstructure was completed February 26, 1908. Work on the Willamette River Bridge was begun August 11, 1906 and the first train between Portland and Vancouver was moved on November 5, 1908, and regular passenger service began November 17, 1908.

The bridges and connecting tracks are double track and are now being used by the Northern Pacific, the S. P. & S., the Great Northern and the O. W. R. & N. of the Union Pacific System.

Mr. W. L. Darling was Chief Engineer of the Northern Pacific and S. P. & S. at that time, and Mr. Ralph Modjeski was in charge of these two great bridges.

As time goes on, this S. P. & S. line to Astoria and this entrance to Portland will play a more and more important part in the development, commercially and socially, of that interesting part of our country between Portland and Bend, Oregon on the south, Astoria on the west, Vancouver, B. C. on the north, and east into the Inland Empire and Columbia and Snake River Basins.

Attached to this paper is a memorandum giving some details and prints of this most important and interesting work.

*Work on the
New Haven*

On the New Haven, it became absolutely necessary to add to the capacity of that property if it was to serve the large population tributary to its rails. I asked Mr. Pearson to associate himself with the property and with him plans were developed for work that is gradually being finished under his direction, which increases the ability of the property to handle its heavy freight tonnage and numerous passenger trains and reduces the cost per unit of transportation produced.

Two very important pieces of work are the large freight yards at New Haven and Providence.

*Importance of
Engineer to
Transportation*

I mention some of these things to emphasize the very great importance of the engineer in the transportation problem of the country, not only in creating the original transportation machine, but in perfecting it so that there will be the maximum output at a minimum cost in these days of complications and high wages and other costs, affecting the administration of any industrial plant. Also to tell you how much benefit my education as an engineer and my association with engineers has been to me in my part of the work in the railroad world.

"Railroad Transportation." Your good President, Mr. G. S. Webster, has asked me to say something about "Railroad Transportation" so vital to the present and future development of our country and our people, agriculturally, industrially, financially and socially. For without easy means of communication, it is obvious the highest development of our wonderful resources and the consequent improvement of living conditions cannot be obtained.

Record of Half a Century Look for a moment at the development of our railroad system in a half century. A development made possible by men of imagination, vision and courage; by financiers and investors who took long chances; and last, but not least, by engineers who have been able to carry into effect the plans and purposes of the other two groups.

TABLE I.
Miles of Steam Roads—Single Track—Owned.

	United States	Eastern District	Southern District	Western District
1870 (June 30)	53,399	27,068	11,888	14,443
1920 (Dec. 31)	253,708	61,296	51,274	141,138
Per cent increase	375	126.	331	877
Population				
1870 (June 1)	38,558,371	21,693,654	7,899,435	8,965,282
1920 (Jan. 1)	105,710,620	51,565,264	18,356,714	35,788,642
Per cent increase	174	138	132	299

TABLE II.

Urban and Rural Population: (Urban population comprises that residing in cities and other incorporated places of 2,500 inhabitants or more, and in unincorporated towns of 2,500 or more in Massachusetts, New Hampshire and Rhode Island.)

	Urban	Rural	Urban	Per Cent
1880	14,358,167	35,797,616	28.6	
1890	22,298,359	40,649,355	35.4	
1900	30,380,433	45,614,142	40.0	
1910	42,166,120	49,806,146	45.8	
1920	54,304,603	51,406,017	51.4	

It is interesting to note that railroad mileage has increased twice as fast as population (mileage 375 per cent—population 174 per cent). In the great empire west of the Mississippi mileage has increased 877 per cent, and population 299 per cent.

This indicates clearly that the men of courage and vision, the men with ability to raise money, the engineers with ability to design and construct have done a great work in providing the present marvelous transportation machine that is so essential if our 107,000,000 people who are crowding too much into cities and away from the country, are to be sheltered, fed, clothed, kept warm and safeguarded in their various occupations and in their homes. These men ought to receive commendation and thanks for what they have done and made possible for the country

and the great transportation machine ought to be allowed a living and be encouraged to expand.

Unfortunately for the future growth of the country there is too great a tendency on the part of the public and the law-makers to see only the minor mistakes incident to the creation and operation of this great transportation engine, performing such prodigious work for all (hampered by many laws) and failing to appreciate the whole wonderful work and what the Nation would be without it. They hold the "penny" of failure so close to their eyes that they do not always see the "twenty-dollar gold-piece" of accomplishment.

Growth of the Country What have our virile people done in 50 years? Marvelous accomplishments made possible by our wonderful transportation system moving food, fuel, raw materials, finished products and people in vast quantities and over great distances.

TABLE III.
STATISTICS OF RECORD OF PROGRESS OF THE UNITED STATES
1870 AND 1920

ITEM	1870	1920	Ratio
Wealth	\$30,068,518,000	*300,000,000,000	1:10
Per capita	779.83	*2,839	1: 3.6
Public debt, less cash in treasury	2,331,169,956	24,330,889,731	1:10
(July 1)	30.46	228.63	1: 3.8
Public debt, per capita	2,046,455,722	24,061,095,361	1:12
Interest-bearing debt (July 1)	118,784,960	1,016,592,219	1: 9
Annual interest charge**	.....	9.55	1: 3.1
Interest per capita**	3.08	6,087,558,087	1: 9
Total money in circulation (July 1)	676,284,427	57.21	1: 3.3
Total money in circulation per capita (July 1)	17.51	8,507,145,000	1: 5.6
Total value farm animals	1,518,465,000	308,720,000	1: 1.9
PRODUCTION OF PRINCIPAL COMMODITIES			
Wool (pounds) **	162,000,000	787,128,000	1: 3.3
Wheat (busheis) **	235,584,700	3,232,367,000	1: 3
Corn (bushels) **	1,094,255,000	12,987,000	1: 3.2
Cotton (500 lb. bales gross weight)	4,024,527	a 1,491,944,444	1:27
Rice (pounds)	54,888,880	1,452,902,000	1:1803
Sugar (beet) pounds	b 87,043,000	244,250,000	1: 2.8
Sugar (cane) pounds	87,043,000	b 49,509,400	1: 1
Gold (dollar-com.) value **	16,434,000	57,420,325	1: 3.5
Silver (dollar-com.) value **	16,434,000	41,375,000	.....
Aluminum (pounds) **	.....	96,944,000	.....
Cement (barrels) **	.....	576,431,250	1:20
Coal (long tons) **	29,496,054	12,600	539,759
Copper (long tons) **	.....	17,830	476,849
Lead (short tons) **	17,830	.....	1:27
Mineral waters (gallons sold) **	.....	40,000,000	.....
Natural gas (dollars) **	.....	(1919) 162,000,000	.....
Petroleum (gallons) **	220,951,290	18,622,884,000	1:84
Phosphate Rock (long tons marketed) .....	.....	4,103,982	.....
Iron Ore (long tons) **	3,031,691	69,558,000	1:23
Pig Iron (long tons) **	1,065,179	36,925,987	1:22
Steel (long tons) **	68,750	(1919) 34,671,232	1:504
Total minerals (dollars) **	218,598,994	6,707,000,000	1:31

MANUFACTURING INDUSTRIES OF UNITED STATES					
Cost of material used.....	(\$1,031,605,092)	(1914)	14,368,068,831	1:14	
Value of products.....	" 1,885,861,676	"	24,246,434,724	1:13	
Manufactures of cotton (value).....	" 115,681,774	"	701,300,933	1: 6.1	
Manufactures of wool (value).....	" 73,454,000	"	464,249,813	1: 6.3	
Manufactures of silk (value).....	" 6,697,771	"	254,011,257	1:38	
Total expenses public schools (1870)	63,396,666	(1918)	763,678,089	1:12	

* Estimated.

** Calendar years.

a Figures include only about 45% of California crops.

b Approximate.

SOURCE: Statistical Abstract of the United States, 1920.

Population, production, wealth and comforts have increased. Schools, colleges, libraries, hospitals and attention to the sick and poor are all on a much larger and better basis due to the growth of the country and the use of its resources. And in all of this the railroads were and are absolutely essential, but they have not prospered accordingly.

*Railroad
Transportation
Furnished*

This development has been possible by the movement of an enormous number of tons of freight and passengers one mile, as shown by

TABLE IV.

PRODUCTION AND CONSUMPTION OF TRANSPORTATION

Fiscal Year	Population	Tons 1 mile		Passengers 1 mile
		Tons 1 mile per person	Passengers 1 mile per person	
1900	76,129,408	141,599,157,270	16,039,007,217	
1905	84,219,378	186,463,109,510	23,800,149,436	
1910	92,267,080	255,016,910,451	32,338,496,329	
1915	99,340,635	277,135,000,000	32,475,000,000	
1917	102,172,845	*398,263,061,787	*40,099,757,819	
1918	103,587,955	*408,778,061,079	*43,212,458,079	
1919	105,003,065	*367,161,370,571	*46,838,165,980	
1920	106,418,175	*413,675,000,000	*47,366,000,000	
†1921	107,833,284	*324,000,000,000	*37,700,000,000	

* Calendar year

† Estimated

Enough passenger transportation in a reasonably good year to give every man, woman and child a trip of more than 350 miles, and handling enough freight transportation to haul between 3,000 and 4,000 tons one

mile for each one of them; equivalent to handling more than ten tons of freight one mile every day in the year for every man, woman and child in the country.

Safety

Thirty years ago, the average traveler took eight railroad trips a year, and now he takes twelve. Then he averaged 24 miles a trip, and now 38 miles. Notwithstanding he rides more frequently and greater distances than formerly, yet the danger to life is far less than it used to be.

The railroads of the United States carried in 1920 about 1,300,000,000 passengers, with one killed for each group of 5,673,000 carried. In a total of 472,000,000 people carried in 1889, the death rate was one in 1,523,000. The danger to life of railroad travelers in 1920 was therefore less than one-third of what it was in 1889, most of the reduction accruing since 1907. To be sure, there have been years when the proportions were higher and lower, but the general trend throughout the whole period has been decidedly toward the increasing safety of the traveling public.

The Inadequate

*Pay of the
Railroads*

As an abstract question any fair-minded man will say that "The Laborer Is Worthy of His Hire," and that the railroad should be compensated justly and even generously for the service rendered, so as to provide for the future when more and better transportation will be needed. What has been the result? The following table shows:

Year Ended June 30	Net Railway Operating Income	Property Investment	Rate of Return—%
1911	\$724,184,708	\$14,246,167,475	5.08
1912	708,484,383	14,632,497,022	4.84
1913	787,610,435	15,284,763,489	5.15
1914	661,018,147	15,842,127,273	4.17
1915	683,104,833	16,257,146,632	4.20
1916	984,872,599	16,688,440,056	5.90

Year Ended Dec. 31	Net Railway Operating Income	Property Investment	Rate of Return—%
1916	1,040,084,517	16,884,440,038	6.16
1917	934,068,770	17,762,152,127	5.26
1918	638,568,603	18,213,629,613	3.51
1919	454,984,953	18,529,749,653	2.46
1920	21,661,782	19,134,000,000	0.11
*1921	542,409,582	19,694,622,226	2.75

* 12 months ended September 30, 1921. The returns for this period include 15 large switching and terminal companies.

Obviously a return wholly inadequate if private ownership is to be sustained and if Government ownership is to be avoided.

Now, the country and the railroads are in some distress; agriculture is in trouble, industry is slack and business is poor. The railroads realize this but those who are now advocating that one way to bring about a resumption of business activity is to still further reduce the railroad income should be careful.

Economic Adjustment, Inflation and Deflation.

I would like to say a word about "inflation" and "deflation." During the war, agriculture and industry generally, and wages, were more or less inflated, and there were received very much higher prices for food, fuel and articles produced than prior to the war, and wages were increased. Farmers and farm plants improved their condition very much, and agricultural lands were sold at prices never before dreamed of. Securities representing manufacturing plants were much higher in value and in price. And a great many manufacturing enterprises were able to make their prices during the war on such a basis that there were large profits, either in money or in additions to their plants and facilities, so that they are now in a much better position than they were before the war.

I think all will admit that there was a period of inflation and of considerable prosperity for the farmer, the manufacturer and the wage earner. It was not, however, so for the railroads. They received a scanty living through payments from the Government, in order to keep them going; but, unfortunately, their properties were returned to them deteriorated as to their physical condition, demoralized as to their personnel, and with many new and difficult methods of management and high wage costs imposed upon them.

These conditions growing out of war and Governmental control are being corrected slowly by the hardest kind of work between the managements and the men, and with the Governmental agencies, which, under the Transportation Act, have the final power in each of these matters.

All Must Share the burden of Deflation

Deflation today is taking place in many directions, and all must bear part of the burden. The farmer has felt the full force of this, and from the high and prosperous condition in which he lived during the war, he has had to come down a long way. And this naturally hurts him, and the whole situation, and he, not unnaturally, looks around for relief.

The railroads believe that agriculture is one of the fundamental industries in this country and that they should help it by a moderate reduction in rates as one step in trying to help the existing situation—not because they can afford to do it out of their present returns, but just upon the ground of helping out.

Manufacturing enterprises are also deflating, and the same may be said about the jobbing and distributing business.

It is a slow and difficult process, but here again these two classes of human industry had, during the war period, the chance for great prosperity, large profits and great additions to their plants, and many of them availed themselves of that opportunity, but the railroads did not have that chance.

What is generally described as "labor" has already been hurt by unemployment and by some reduction in wages, which, however, has not yet affected the great transportation interests to the extent that it should, if what some of the people of the country think is needed: namely, lower transportation charges, are to be obtained.

It would seem as if labor, through its great leaders, ought to recognize that this deflation process is going on and admit that it must come and

allow a lower unit of wages in many directions, not only on the railroads, but in the mines and in the building trades, all of which would mean the employment of more men, a lower unit price on many articles that are used by all, and thus tend to reduce the cost of living and help to break the present endless chain of expense.

Mr. Julius Kruttschnitt, in his interesting and readable article in the *Atlantic Monthly* for January, makes the following statement about the direct labor costs to the railroads, as the result of the Adamson Law, other Federal and State Laws of a restrictive character, the war, and the practices developed during Federal control and action by the Labor Board:

"The Labor costs of Class 1 carriers were 113 per cent higher in 1920 than in 1917, preceding Federal control; and if the increased wage-scale had been in effect during twelve, instead of only eight, months of 1920, the increase would have been about 125 per cent. The Government during its control allowed gross revenues to increase less than 54 per cent. Labor-costs have risen since the Government took charge of them in 1916, under the Adamson law, from \$1,468,576,000, to \$3,698,216,000, the total amount paid to labor during 1920 being *very nearly sixty times the \$61,928,626 of net income yielded by the operation of the railroads.*

"The history of the direct labor increase is interesting and important.

The labor bill of Class 1 carriers in 1916, before the Adamson Law took effect, stood at..... \$1,468,576,394
In 1917, when the Adamson Law was in effect, the labor bill was..... 1,739,482,142

An increase over 1916 of..... 270,905,748
This was increased by the Railroad Administration
in 1918 to..... 2,613,813,351
Or an increase over 1917 of..... 874,331,209
This was further increased in 1919 to..... 2,843,128,432
Or an increase over 1918 of..... 229,315,081
This was further increased by the Railroad Labor Board in 1920 to..... \$3,698,216,351
or \$10,132,000 FOR EVERY DAY OF THE YEAR.

"The increase in *labor alone*, from 1916 to 1920, was \$2,230,000,000—nearly equal to \$2,357,000,000, the total operating expenses of all Class 1 roads in 1916, which include, not only cost of labor of every description, but cost of materials, fuel, depreciation, loss and damage to freight, injuries to persons, insurance, and the rest.

"After the return of the railroads to their owners, they were made to perform the *greatest transportation task in their history*. They moved more freight and passengers, loaded their cars more

heavily, and moved larger train-loads. That it cost too much to do this was due, as shown, almost entirely to causes beyond the railroad managers' control."

The Railroads as Buyers of Materials

A reasonable policy of labor deflation would be extremely helpful because the wage bill of the railroads is so very large a part of their total expenses, and they are such heavy buyers of materials, the cost of which is made up so largely of labor. When they are on the up-grade, as all know, they are very large buyers—perhaps the largest buyers—of many articles, which means employment to men and a greater demand for food and other articles, thus helping all along the line.

Rates

The country pays a very big bill—through rates—for the transportation service furnished by the railroads. But the country is a very big country, and the amount of transportation furnished is very large. *The production of it is extremely costly and today there is no adequate return to the plant that furnishes the service.*

The returns, after expenses and taxes, for 1921 (partly estimated) will not exceed \$616,000,000, not quite enough to pay fixed charges of about \$640,000,000, including interest on bonds, so widely distributed among individuals and held by insurance companies, savings banks and charitable institutions, thus leaving nothing for improvements or the stockholder, which might be all right if the roads had been allowed in the past, as other industry has been, to earn liberally in other years. And this meagre result was only obtained by the cutting of maintenance and repair work to the lowest limit consistent with safety. It has been estimated that in 1921 more than \$400,000,000 of maintenance and repair work was postponed, and sooner or later this work must be done.

It should be remembered that for many years prior to the war the general level of rates was not sufficiently high to protect this national industry of transportation, and there was danger to everybody, to agriculture and to all kinds of industry, of the supply of transportation not being adequate for the needs of the country. Therefore, to cure that economic difficulty, effort was made through the Transportation Act and through the rates permitted by the Commission under that Act.

These rates are higher than they were before the war, but they were then far too low for safety, and we are comparing today with an indefensible basis, if the country is to continue private operation and ownership of railroads, subject to public regulation.

Critics of the general level of rates ought to remember and consider how out of balance rates were before the war and that today, while some rates may be too high, the general level of rates approved by the Interstate Commerce Commission in 1920, with numerous adjustments made since, is not too high, considering what the railroads have to pay for wages, fuel and supplies generally; and it should be remembered that the increase in this country because of changed conditions has not been nearly so great as the increase in transportation charges in many other countries which have suffered from the same world-wide conditions

that we have because of the increase in wages and the price for fuel and materials used by their respective transportation systems.

Rates, in Earlier Years, Too Low

Again, the railroads of this country have always believed in making as low rates as they possibly could, and some think they went too far at times. In fact, the Transportation Act recognized that danger by giving to the Commission the power to name the minimum rate as well as the maximum. The railroads want as low rates as they can afford, because of the great distances here and because they want the widest distribution and the greatest exchange of all kinds of commodities.

The owners and managers, however, of these great railroads are trustees, holding these properties for giving service to the public, as well as to earn a return, and they must, in making their rates and in presenting facts to the public about their business, about the charges they make for service, realize that they have a paramount duty in maintaining a safe and adequate transportation machine, and in managing it honestly, efficiently and economically.

To permit wastage through inadequate rates means a deterioration of the properties within their charge, which will tend to prevent their serving the public adequately; and to permit such wastage is not honest, efficient and economical, any more than it is to permit wastage in labor, if they can control it, or in the use of material or in any other form of management.

Many Other Factors to Consider Besides Rates

Rates, of course, have a bearing on the development and success of agriculture and of industry; but they are not the only important element in the problem that must be considered before improved business conditions obtain.

For example, today the labor cost of putting up a house is far more important than the rate on the material itself, and the labor cost is a much greater deterrent to solving the important housing problem of the country than is the railroad rate. This labor cost goes back into the lumber, the steel, the iron, the brick, the cement, into the railroad rate, and it is very evident in the wages received by the men actually engaged in placing the material, after it has been put on the ground, in the form of a house.

It is very important, not only for the railroads but for the public, to be just and without prejudice, and to realize that there are a great many factors besides rates which are affecting business today.

A sweeping reduction in all rates would not, in my judgment, at this time increase business, for many other things must be settled before we obtain what all desire—that is, a complete revival of industry in this country.

I refer to such matters as the various foreign questions, which seem to be in a fair way of adjustment by the conference now going on in Washington; the tariff question, which Congress now has in hand, and which is most difficult; the tax question, which has been partially settled and which is even more difficult than this railroad rate question, and the general financial condition of the world.

The Transportation Act A word now about the Transportation Act, which today is the guide for the railroads, the regulatory bodies and the public. The country debated the general subject for a long time—Congress did the same—and finally passed the bill. It has been the law only about twenty months. During some of those months business has been depressed and disturbed, and I think it can truthfully be said that the Act has not had a fair trial.

Only a little more than a year ago the cry of the country was not about rates, but about the inability of the railroads to handle all business promptly. That condition is likely to exist again, when business resumes, if proper steps are not taken.

The country, in that Act, declared for a national railroad policy, and the supreme power of the nation, through the Commerce Commission and the Labor Board over questions of dispute as to rates and regulations thereof and wages and working conditions, respectively; also for a policy of self-support for the railroads out of the rates charged for transportation furnished to the public. The public, after this long debate, turned away from the doctrine of supporting their transportation system through taxation, and also turned away from Government ownership. It seems to me that it will be most unfortunate for the country to turn back to Government operation or ownership because of the present difficult conditions, from which the country will emerge in due time.

Economies in Transportation Improvements in transportation practice have been very continuous for a long term of years, and the total accomplished is apt to be lost sight of. Not so many years ago all the land transportation in the country was furnished by packing on the backs of men or animals; today there are being handled with the aid of less than 2,000,000 men, more than 400,000,000,000 ton miles of freight each year. The physical effort to do this represents, under the old methods, the labor of about 1,250,000,000 men, and the cost to the public has decreased from \$3 to about 1 1/4c per ton per mile, based on 1921 returns.

Of course, it would be impossible to apply this amount of man power, but the comparison is given to show how the efficiency of the railroads has released untold man power for the great development of the country in many other directions. It may be argued that highway transportation would have developed even more than it has if the railroads had not been here and the country therefore served by highways and waterways.

But without the railroads—the primary form of transportation in the country—the motor vehicle, the gasoline to propel it and the hard surfaced roads never could have been developed except to a limited extent.

Every progressive railroad manager knows that some further economies are possible, but they depend very largely on two factors that cannot be made effective at once.

First, the spending of money for capital account in the creation of better facilities. Second, the actual price paid to the individual workman and the development in him of a spirit that it is his duty as an American citizen, to do all that he can to bring down the cost of transportation because of the help such reduction will be in working out the soundest

possible general economic scheme for the whole country. This same idea, in my humble opinion, ought to be applied to those who work in mines, factories and forests, because fuel and material prices affect all and very largely depend upon the efficiency of the individual man and the wage paid.

The engineer is peculiarly in a position with his trained and accurate mind to help in determining the wisest form of improvements in transportation facilities and practices to be made (if and when money can be obtained) for increasing economies of operation. Among economies that are not completely developed are:

Further decrease in the physical resistance to be overcome so as to lessen the tractive power necessary to haul a ton of freight. Improved location and design of terminals both for handling carloads and merchandise; improved water and fuel stations. Greater economies in the production and use of power from steam and electricity, whether obtained from fuel or water power. Improved design of locomotives and cars so as to have the maximum of capacity and strength with a minimum of dead weight. A better supply of well-designed repair plants equipped with high-powered and rapid-working tools in all shops and roundhouses, where mechanical work is performed. Improved methods of receiving, storing and distributing the great quantities of materials and supplies that are used each day by the railroads. Improved facilities at terminal and division points for the health and comfort of employees. The elimination of waste, which is so prevalent in all walks of American life.

The Future It is not beyond belief at all that within fifty years there will be 250,000,000 people in this country. They can be well taken care of if all hands will co-operate and work. Vital to their well-being, however, will be an adequate transportation machine. Today the country has one made up of the railroads, seaways, waterways, highways, and motor transport representing great values, possibly \$60,000,000,000 or next to agriculture as an element of national wealth. Of this the present railroad system, on any fair basis of allowing for good-will, strategic position, experienced organization and all the elements that enter into values of other classes of property, is probably worth \$25,000,000,000. When there are 250,000,000 people here, a ton mileage of even 3000 per annum instead of 4000 now, to give them as good a living as is being furnished today, will mean the movement of 750,000,000,000 ton miles a year, plus the added passenger travel—double that now provided.

So, the present great transportation machine must be added to enormously, possibly doubled, not in mileage, but in capacity and coordinated with other forms of transportation. Great sums of new capital must be obtained, probably more than \$25,000,000,000 and this can only be obtained if there is safety for the principal and a fair annual return.

The engineer is particularly interested in having this work go on

because of the important part he will play in it, as well as in the development of economies in the existing system.

The country and the world are somewhat in the "dumps," but times will change and conditions will be better.

I believe the United States is on the threshold of the most glorious period in its history and that we can take a place in the history of Nations never before achieved if we will only think right, work hard, and use carefully our great powers and resources. And the transportation machine should at all times be kept adequate to the growing needs of the country.

The Engineer and Social Progress is a great engine for advancing civilization.

The engineer has played a most important part in creating and operating this engine. But with the great development in this country and crowding of people into cities have come perplexing social problems which must be attacked and solved if the country is to achieve its highest destiny.

Some of these are:—

(a) *Better Use and Conservation of Natural Forces and Resources.*

Nature has been generous to the United States and we have not been obliged to save in the past as much as we must in the future. The Engineer, by perfecting the processes for developing and conserving our resources can help to bring about better living conditions for all and promote National Health and National Safety. Think of the possible development in the next fifty years along the lines of

Fuel Conservation.

Use of Cheaper forms of Coal for Power.

Water Power Development.

Control of the Flood Waters in Valleys.

Control of Water in the Mountains for Irrigation.

The better use of natural forces and the elimination of waste in use of natural resources are most important.

(b) *Decentralization of Population.*

In 1880, 14,358,167 people lived in cities and towns and 35,797,616 in the country.

In 1920, this had changed to 54,304,603 for cities and towns and 51,406,017 in the country.

Cheaper fuels and wider distribution of power will permit a wider use of mechanical devices, on the farm, in the small factory and in the home, and by increasing comfort and convenience in the country, check the drift to the city.

(c) *Better Rewards for the Farmer Who Provides Food for All.*

The cost of living can be reduced if there is a national policy leading to better use of resources, and more people willing to produce food.

Agricultural and farm life must, however, offer attractions and rewards to the young people equal to what they think they can obtain in the cities.

(d) *The Relation of Labor and Capital.*

The distribution of the annual increment of wealth in the country very properly is a subject that engages the attention of everyone. Everyone naturally desires to obtain all he can consistent with regard to others. Out of this natural effort have developed great organizations of Labor and of Capital. Such organizations are all right if wisely and honestly directed. Labor Unions are all right when they are so conducted that waste is eliminated; and they are an efficient and economical instrument of society as a whole. When they cease to be that, their usefulness is gone and society will get rid of them. There is a place in this country for wisely directed Labor Unions, but no place for Labor Tyranny.

Society some time ago discarded the club, the sword and the pistol as weapons for the settlement of personal disputes. Society is getting ready to discard the strike as a weapon for settling industrial disputes because it is inhuman and uneconomical—the sooner the better for the good of all.

The engineer is of great importance because of his technical knowledge and trained mind. But he is of almost greater importance as a citizen because he has been trained to be accurate in thought, his calculations must check out or he fails. He can be of great value in working out some of these social problems and he can and should counteract the loose thinking and talking that is more or less prevalent resulting in the advocacy in legislative halls, on the stump, in the parlors, of foolish doctrines that never have worked and never will.

The great majority of people in this country, as individuals, are sensible, hard-working, and home-loving; but collectively, they are sometimes led astray through lack of accurate information and clear thinking. The war developed a spirit of extravagance and unrest, and there is a noisy minority doing a great deal of talking, and advocating what for want of better names are known as Radicalism, Socialism, Bolshevism and the use of remedies that will do more harm than good. The engineer, as a citizen, can use his trained mind to help prevent the theorists and adventurers from leading the country astray so that we may jump out of the "frying pan" of admittedly difficult conditions into the "fire" of much worse ones.

The engineer, accustomed to basing conclusions upon accurate facts, can help create a public opinion:

That an adequate transportation machine is a necessity;

That it cannot be had without paying for it;

That the present railroad system was developed by giving the initiative of the American man some chance to work and to obtain rewards;

That better results can be obtained in the future if that initiative be allowed once more to be used without all of the hampering and restrictive laws of Nation and States that have been put on the Statute Books in the last twenty-five years.

Railroads are common carriers of people and property; they are not common carriers of all the economic troubles of the country. These cannot be cured by reducing rates, by ruining the railroads and perhaps forc-

ing Government ownership to which this country is opposed. Give Brains, Courage and Management a chance once more. DECLARE A TEN-YEAR HOLIDAY IN THE CEASELESS INVESTIGATION OF THE TRANSPORTATION QUESTION AND LET THE UNDIVIDED ATTENTION AND ENERGY OF OWNERS, MANAGERS AND EMPLOYEES BE DEVOTED TO MAINTAINING, OPERATING AND PERFECTING THIS ENGINE OF CIVILIZATION—THE WONDERFUL RAILROAD SYSTEM OF THE UNITED STATES.

The American Society of Civil Engineers, and its members all over the United States, are a powerful influence for wise and economical work along technical lines. They are and can be a powerful influence in moulding public opinion along sane lines, so that our National problems will be settled in the interest of all the people. But all hands must work. There is an old hymn of three stanzas, one of which reads:

We are not here to play, to dream, to drift;
We have hard work to do, and loads to lift;
Shun not the struggle—face it, 'tis God's gift.

This is good doctrine for all of us in these days when the world is trying to adjust itself.

NOTE:

Figures obtained from the Statistical Abstract of the United States and the Bureau of Railway Economics. Net Railway Operating Income of \$61,928,626 used by Mr. Krutschmitt was compiled from monthly reports of 1920 before final annual reports for that year were received. The Net Railway Operating Income of \$21,661,782 is a more recent figure obtained from the annual reports of the railroads after all corrections in the monthly accounts and adjustment of Federal Lap-Overs had been made.

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